2016

The Adaptive Memory Effect: Exploring Need for Cognition and Survival Processing

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The Adaptive Memory Effect: Exploring Need for Cognition and Survival Processing

by

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A thesis submitted to the Department of Psychology

In partial fulfillment of the requirement for the degree of

Master of Science in Psychology

UNIVERSITY OF NORTH FLORIDA

COLLEGE OF ARTS AND SCIENCES

April, 2016

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Abstract

Adaptive memory demonstrates that memory is enhanced when information is processed because of its relevance to survival (Nairne, Thompson, & Pandeirada, 2007). In the present experiments we examined whether there was a difference in individuals Need for Cognition (NFC; Cacioppo & Petty, 1982). in regards to adaptive memory. Need for Cognition is characterized as the differences in individual's preference for engaging in thought or information that requires effort. Specifically, individuals high in NFC could potentially think of numerous ways to survive, thus being more likely to generate more thoughts and ideas, ultimately leading to better memory compared to low-NFC individuals. For both experiments participants read survival and moving scenarios and rated words according to each scenario. Participants then received a surprise recall test on the rated words, and completed a NFC questionnaire. Experiment two examined both true and false memories across multiple recall tests. Specifically, participants were given three chances at recall prior to NFC scale. Results for experiment one indicated no effect of high and low NFC but there was an effect of scenario, indicating that the survival scenario led to greater recall than the moving scenario. Results for experiment two for target words, indicated that there was a significant effect for recall test as well as scenario, revealing that the survival scenario led to greater recall than the moving scenario. False memory results indicated a significant effect for test, as participants recalled more false words in the subsequent tests. High-NFC individuals were shown to increase in recall from test one to test three, compared to low-NFC individuals. Explanations for the lack of difference in high- and low-NFC individuals may be diminished from prompting a type processing that succeeds in increasing true and false memories for the low-NFC individuals that is similar to high-NFC individual.

The Adaptive Memory Effect: Exploring Need for Cognition and Survival Processing

Researchers have developed the idea that human memory was sculpted by evolution as a consequence of problems that our ancestors once faced (Cosmides & Tooby, 1987; Sherry & Schacter, 1987). Evolutionary psychologists have stressed the importance of ancestral environments of our past. They argue that our brains contain numerous adaptations, products of natural selection, that are special processing modules (e.g., responses to specific situations in the environment and are only selected for what they are contributing to the survival and reproduction of an individual), which are then dedicated to helping us solve specific problems that arose in our ancestral past (Cosmides & Tooby, 2005; Tooby & Cosmides, 1992). Modules can be considered as minicomputers in the brain that are dedicated to solving specific problems (Cosmides & Tooby, 1997; Fodor, 1983). Tooby and Cosmides (2005) discuss one of the defining characteristics of these hypothesized modules, domain specificity. Domain specificity states that each module has been sculpted, or adapted, by nature to accomplish some specific end, such as surviving from predators. This evolutionary research sparked the interest of understanding memory in an adaptive perspective. Understanding how some memories can be formed through adaptive processes led to what is now known as the survival-processing paradigm or adaptive memory. The paradigm has shown to demonstrate that memory performance is enhanced when individuals understand and remember certain words because of how they may help the individual survive in a certain situation (Nairne, Thompson, & Pandeirada, 2007). It became evident that human memories are adaptive in nature; however, the differences between individuals' adaptive memories remain largely unexplored.

Adaptive Memory

Nairne et al. (2007) discussed an evolutionary-based explanation for how memory is enhanced for its survival aspect. Their paper discussed that natural selection processes evolved the human memory system to prioritize the processing of survival information. In Nairne et al.'s initial study, participants imagined themselves stranded in the grasslands of a foreign land without any survival materials, deprived of food and water, and in danger from nearby predators. The participants then rated words according to the words' relevance to this specific survival scenario. After a surprise memory test that followed the survival scenario, the results demonstrated that processing words in a survival-related context led to better retention than processing words in a number of control conditions. These control conditions were rating items for pleasantness, relevance to a moving scenario, or ease of generating an autobiographical experience (self-referencing). These are all conditions that have resulted in superior memory performances in past memory studies (Nairne et al., 2007).

The survival value of an item heavily depends on the context in which that item is encountered. Nairne et al. (2007) stated that survival processing is a factor of memory, because a word's meaning is context-dependent. This means that the survival value of a word depends on how the individual initially encountered the word. A classic pencil example is commonly used: a pencil is not usually used as a weapon, but if an individual is stranded with only a pencil for survival, then this individual may use the pencil as a weapon (Nairne et al.). Nairne and colleagues studied this concept by exploring the mnemonic value of survival processing rather than the actual survival content of information. For example, they did not test words that were specifically related to survival; rather, the researchers tested words that do not have anything to do with survival, like the pencil example. If the content is in a survival context, more words will

be remembered for its helpfulness regarding the "survival" of the individual, compared to words that are processed in a non-survival atmosphere.

Through many studies, it became clear that when words are rated with respect to their relevance for an imagined grassland survival scenario characterized by predators, lack of food, and lack of potable water, then memory performance in a follow-up surprise memory test was much better than when the same words were rated with respect to their pleasantness (e.g., Nairne et al. 2007, Nairne, Pandeirada, & Thompson, 2008), imagery (Nairne et al., 2008), or their relevance for a control scenario such as the moving scenario (e.g., Nairne et al., 2007). Furthermore, Otgaar and Smeets (2010) found that both true and false recall can be amplified by survival processing in adults and children. It has been speculated that false memories are adaptive as well because "misremembering" details might be beneficial in particular situations (e.g., Sutton, 2009). For example, Stich (1990) used the example of poisonous food. If someone remembered that a type of food is poisonous when it is not poisonous, they will avoid that food altogether. This misremembering impacts the chance of survival and successful reproduction if the individual does not remember this information about the poisonous food. When information is processed due to its survival aspect, the memory is then primed to be related to survival, whether it is true or misremembered (Howe & Derbish, 2010). The information that was once remembered as a survival memory could eventually be crucial in a current life situation.

Mnemonic advantages for survival processing have now been demonstrated using alternative control scenarios (Kang, McDermott, & Cohen, 2008; Weinstein, Bugg, & Roediger, 2008). In one prominent example, survival processing produced better memory than a control scenario involving the planning and executing of a bank heist (Kang et al., 2008). The bank heist scenario was chosen to match the potential excitement and thrill of the survival scenario, which

was something that was thought to be lacking in the moving control scenario often used by Nairne et al. (2007).

Soderstrom and McCabe (2011) found that when participants imagined having to protect themselves from zombies, it led to better recall than the original grasslands survival scenario. Although this is still a scenario related to an individual's survival, the scenario challenged the ancestral background of the context (Nairne & Pandeirada, 2010). The fact that the zombie scenario led to higher recall than the ancestral survival scenario tested the idea that the most effective survival processing type is specific to only certain ancestral environments. This led researchers to question whether it was the environment that was important from the scenario, or rather the type of processing that can be instigated by the survival scenarios. This led to further research to determine if the ancestral environment within the scenario was more important than the type of processing caused by the scenario.

Various Scenarios and Types of Processing

There are many different routes of explaining the 'why' of the survival-processing effect. Klein, Robertson, and Delton (2011) discussed that planning for the future is a necessary component of why the survival scenarios resulted in exceptionally better recall than non-survival scenarios. Planning and having an orientation towards the future are two clearly interrelated skills, and in turn could greatly enhance an individual's chance for survival. Klein et al. (2011) examined whether an individual's adaptive memory is influenced by planning for a survival scenario. An example of a survival episodic planning memory task would be asking the participants, "Which items would you take with you to survive if you were stranded in the savannah?" Klein et al.'s experiments demonstrated higher recall performance on a survival episodic planning memory task, which included an aspect of survival and planning. For example,

the survival scenario problem that involved planning was struggling to survive to reproduce and develop offspring. This episodic planning memory task had higher recall than when the scenario that did not include the planning aspect of reproducing and developing offspring and instead was just the typical survival scenario. Klein et al. explained that planning for future contingencies is an evolved set of mechanisms designed to help solve a general problem. The adaptive memory effect can be mediated by planning to solve a problem, past or present (Schacter, 2012), and thus the type of processing affected recall even with ancestral environments. This idea of planning describes memory as a combination of processes that enable an individual to think about past experiences to guide current behaviors and also plan for their future (Klein et al.).

Another potential explanation for the adaptive memory effect came from Kroneisen and Erdfelder (2011) who claimed that elaborate encoding might be the immediate cause of the enhanced recall in the survival scenario. Kroneisen and Erdfelder suggested that the underlying survival processing effect made it possible to assume that survival scenarios might stimulate more elaborate encoding, which in turn could lead to better memory. Kroneisen and Erdfelder assumed that relevance ratings in a complex survival scenario would provide a richer encoding context, rather than the control scenarios. For example, if someone is stranded in the grasslands, scourging for food, this may be a more complex thinking task than if someone was moving to a new city. When thinking about the relevance of items from an ancestral context, there could potentially be different ideas and associations that come to mind. When it comes to an individual's survival in a certain context, thinking about potential uses of items may be perceived by individuals as more important, which may motivate them to generate many different survival ideas. These ideas may then be used as retrieval cues to boost participants' recall (Röer, Bell, & Buchner, 2012). To test the richness-of-encoding hypothesis, Kroneisen and Erdfelder compared

the standard grassland survival scenario, which had three survival problems: lack of water, lack of food and threat of predators, against a reduced scenario, which had only one survival problem: the lack of potable water. The results demonstrated a stronger survival processing effect under the standard scenario, but no mnemonic benefit of the survival processing when the participants focused on a single problem in the reduced scenario. They suggested this was because the reduced scenario should have presumably offered fewer opportunities to generate a rich set of ideas. When the researchers used the standard survival scenario, it gave the participants richer and more distinctive encoding, which then increased the survival processing advantage (Kroneisen & Erdfelder).

In a more recent study, Kroneisen, Erdfelder, and Buchner (2013) demonstrated that the survival processing effect vanishes when using an interactive imagery task instead of a relevance-rating task. Kronesisen et al. (2013) had participants read either the grassland survival scenario or the moving scenario. The participants were then asked to either rate the relevance of each item with respect to their scenario or to imagine using the item in their scenario and then rate ease of imagery. This task of interactive imagery reduced recall performance in the survival condition, compared to the relevance rating tasks. Specifically, the interactive imagery task caused the survival-processing advantage to disappear and there was no difference in recall rates between the survival scenario with an interactive imagery instruction and both moving conditions (relevance-rating and interactive imagery). They suggested that interactive imagery distracts participants from thinking about multiple object uses which in turn reduces recall. The researchers concluded that interactive imagery is not the primary process for the mnemonic advantage in the survival scenario. This result is also consistent with the main focus of the aforementioned richness-of-encoding hypothesis.

Individual Differences and Memory

Researchers have started to focus on individual differences and how they relate to memory abilities. One individual difference that has been examined in relation to memory is Need for Cognition (NFC; Cacioppo & Petty, 1982). This individual difference variable reflects the extent to which individuals are inclined to engage in effortful cognitive activities. According to Cacioppo and Petty (1982), individuals who have low-NFC usually just go along for the ride and do not put much effort into thinking or work. A low-NFC individual does not enjoy puzzles or thinking games. The high-NFC category consists of individuals who presumably engage in and enjoy thinking. High-NFC individuals enjoy puzzles, thinking games, and taking on challenging work.

Cacioppo, Petty, Feinstein, and Jarvis (1996) demonstrated that the differences between individuals with low- and high-NFC appear to be rooted from past experiences. Past experience is accessible by memories and individuals' past behaviors, manifested in current experiences. This may influence the processing of information relevant to dilemmas or problems that the individual is facing currently. Whether an individual has a low- or high-NFC could be determined by how individuals shape their memory and remember certain pieces of information. Cacioppo et al. (1996) confirmed that individuals high in NFC are more likely to seek information about a wide range of tasks, issues, and current events than are individuals low in NFC. This finding could be an important factor in the survival-processing effect, because if an individual determines numerous methods on how to survive, they are consistently participating in effortful thinking. For example, continuing with the pencil example mentioned previously, an individual high in NFC could think of numerous ways a pencil could help them survive in the given survival scenario. Cacioppo et al. discussed that if people are thinking about and

elaborating on information, then they will remember this information better than if they are not devoting much cognitive effort to processing it. Elaborating on information may lead to a semantic processing. Kardash and Noel (2000) found that high-NFC individuals are more likely to process information with a deeper semantic orientation compared to low-NFC individuals. The more an individual participates in effortful thinking, the higher recall he or she could experience within a survival scenario.

NFC and False Memories

Need for Cognition and its effect on memory has been an area of interest in cognitive psychology. Specifically, research has shown that people with a high-NFC can be more likely to experience false memories (Graham, 2007; Leding, 2011). Graham (2007) conducted an experiment of whether the individual difference variable of NFC affected levels of false recognition in the DRM paradigm. The DRM paradigm (Deese, 1959; Roediger & McDermott, 1995) involves presentation of word lists consisting of semantic associates to a critical, non-presented word. An example of some of the words could be ‘‘snow, ice, chilly, weather, air, and frost’’ which are all strongly associated with the critical lure ‘‘cold,” which is never presented. The DRM paradigm typically produces high levels of false recognition and recall for the critical lures (Roediger & McDermott, 1995). Graham found that individuals with high-NFC had higher levels of false recognition. It was suggested that it is possible that individuals who were high-NFC were processing the meaning of the listed items, leading to false memories for the related critical lures, when the low-NFC individuals were more likely to process the item-specific information of the listed items. Similarly, Leding (2011) found higher levels of false recall in the DRM paradigm. This was likely caused by the high-NFC individuals being more likely to elaborate on the relationships between the items on the DRM lists, because of their likelihood to

engage in more effortful thinking. Furthermore, repeated retrieval has also been demonstrated to produce more true and false memories (Roediger, McDermott, & Goff, 1997). Repeated-recall tests sometimes elicit what is known as the hypermnesia effect (Roediger & Thorpe 1978), which is when the participant has multiple chances to recall the words and increase across those chances. Leding (2011) found that false recall did in fact increase across subsequent tests, specifically for high-NFC individuals but not low-NFC individuals. Repeated tests may give high-NFC individuals multiple chances to process the meaning of the items in the lists. Another explanation of why repeated tests result in the increase of false memories for high-NFC people is explained within Toglia, Neuschatz, and Goodwin's (1999) "more is less" pattern. The "more is less" pattern explains that when an individual remembers more studied items, it leads to more memory errors resulting in false memories.

A theory that has advanced to explain false memories is the Fuzzy-Trace Theory (FTT; Brainerd & Reyna, 2002). Fuzzy-Trace Theory posits two types of memory traces: verbatim traces, which are characterized by a mental reinstatement of the related features of a past event and gist traces, which form a representation of an event's semantic features rather than the surface details. According to FTT, true memories are strengthened by verbatim traces or recollective retrieval and gist traces, whereas false memories are developed due to reconstructive processes based on the gist traces, or nonrecollective retrieval. Considering FTT predicts that any manipulation that increases gist memory processes will enhance both true and false memory rates, Otgaar, Howe, Smeets, and Garner (2014) discussed that survival processing causes participants to rely more heavily on gist processing, which in turn may affect both true and false memory levels. This is a result of individuals retaining multiple memories, causing false memories to occur. Consistent with FTT, a study conducted by Toglia et al. (1999)

demonstrated that false recall of semantically related distractors was more persistent over time than the accurate recall of target words. As there are many opportunities to process gist-related information for the DRM paradigm, it initially produces strong gist representations that remain more stable over time.

Leding (2013) discussed that high NFC individuals were more likely to experience higher rates of false memories in the DRM paradigm but not the memory conjunction paradigm. In the memory conjunction paradigm participants are presented with compound words such as "blackmail" and "jailbird." When the participants are tested, they are presented with previously studied words, words that are composed of features of the previously studied compound words, which are referred to as conjunction lures (e.g., blackbird) and words that are composed of one previously studied feature and one new feature, and these are referred to as feature lures (e.g., blackboard). Leding (2013) as well as Brainerd, Wright, Reyna, and Mojardin (200l) discussed that the DRM paradigm often leads people to false recognition of the lures, but the participants are also often likely to reject the lures because of their verbatim trace for the studied items (e.g., "I know it wasn't blackbird because I remember studying blackboard"). This process has been called recollection rejection (Brainerd et al., 2001). This specific type of paradigm will allow the individuals to easily use the verbatim trace to reject lures, which in turn gives individuals the opportunity to avoid false memories. The results of Leding (2013) indicated that all false memories for individuals are not created equally because even though individuals with a high NFC were more likely to experience false memories in the DRM paradigm (Graham, 2007; Leding, 2011), they were not more likely to experience false memories in the memory conjunction paradigm because they were more motivated to use recollection rejection (Leding, 2013). The high NFC participants were more motivated to engage in the memory editing

strategies that allowed them to avoid making memory errors. This demonstrates that even though the false memory results of Leding (2013) are not consistent with those of Graham (2007) and Leding (2011), these results are consistent in showing that high NFC individuals are more likely to elaborately process information during memory tests. This is to either make connections between semantically related items, and therefore increasing false memories in the DRM paradigm, or to try to use the strategic process of recollection to reject lures and avoid false memories in the memory conjunction paradigm.

NFC and Adaptive Memory

Nairne et al. (2007) concluded our ability to remember and reconstruct the past evolved to help us solve problems, particularly problems related to survival. If that statement is correct, it could be possible that NFC could be a factor in the adaptive memory effect. Kroneisen and Erdfelder (2011) argued that the survival-processing effect is traceable to the richness of encoding triggered by the survival-relevance-rating task. Kroneisen and Erdfelder assumed that relevance ratings in a complex survival scenario provide a predominantly inspiring and rich encoding context, which enables elaborate and distinctive encoding more than previously used control tasks and scenarios. High-NFC individuals engage and participate in effortful thinking. It may be possible that individuals high in NFC focus more on rich encoding, and identify more uses of items in the survival processing condition, compared to individuals low in NFC. Therefore, high-NFC individuals may experience the adaptive memory effect of better memory for words processed related to survival for true and false memories.

The present research examines the adaptive memory effect and how it may be related to NFC. In study one, participants read a survival and moving scenario and processed words from each scenario. The participants were given a surprise recall test, followed by a NFC

questionnaire. It was hypothesized that high-NFC individuals would recall more words than low-NFC individuals and the survival scenario would lead to greater recall than the moving scenario. A significant interaction was predicted indicating that high-NFC individuals would have a stronger overall adaptive memory effect than low-NFC individuals. In study two the participants were given the same survival and moving scenarios, but processed words from six DRM lists, followed by three successive surprise recall tests from the DRM lists. Following the recall tests, the participants were given the NFC questionnaire. For the second study, it was hypothesized that high-NFC individuals would recall more true and false words than low-NFC people and the survival scenario would lead to greater true and false recall than the moving scenario. It was also hypothesized that there would be a significant main effect of the hypermnesia effect, specifically there would be higher recall in subsequent tests. Lastly, a significant interaction was predicted indicating that high-NFC individuals would recall true and false words from the DRM lists overall in the adaptive memory effect than low-NFC individuals.

Experiment 1

Method

Participants. Fifty-five University of North Florida undergraduates participated for extra credit towards their Psychology course or compensation of five dollars. The compensation was supplied from the University of North Florida Graduate Research Grant. There were 37 women and 17 men. All of the participants were native English speakers. The ages ranged from 18 to 44 (M = 22.00, SD = 5.43). Informed consent was obtained from each student. Students were tested individually or in a group up to four, in sessions that lasted approximately thirty minutes.

Materials. The same thirty-two target words as Nairne et al. (2007) were used. There were sixteen words using the survival scenario (S) and sixteen words using the moving scenario (M)

that were rated. The rating condition was blocked in trials of eight words in the form SMSM or MSMS. The scenarios were taken from Nairne et al. (2007) study:

> **Survival.** In this task, we would like you to imagine that you are stranded in the grasslands of a foreign land, without any basic survival materials. Over the next few months, you'll need to find steady supplies of food and water and protect yourself from predators. We are going to show you a list of words, and we would like you to rate how relevant each of these words would be for you in this survival situation. Some of the words may be relevant and others may not—it's up to you to decide.
>
> **Moving**. In this task, we would like you to imagine that you are planning to move to a new home in a foreign land. Over the next few months, you'll need to locate and purchase a new home and transport your belongings. We are going to show you a list of words, and we would like you to rate how relevant each of these words would be for you to accomplish this task. Some of the words may be relevant and others may not—it's up to you to decide.

The Need for Cognition Scale (Cacioppo & Petty, 1984) was used to assess NFC. The eighteen question scale included questions like "The notion of thinking abstractly is appealing to me" and "I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought". The questions were answered on a scale of 1 = extremely uncharacteristic to 5 = extremely characteristic. The Cronbalch's alpha for the NFC scale was .89.

Procedure. All participants were tested in the same lab, and sat at one of the four computers. The computers had high borders between them, to block participants' views from one another. The participants were asked to not make noise or distract other participants in the lab.

The materials (two pieces of notebook paper and the NFC scale) were organized on a clipboard, with the NFC scale placed upside down first ensuring participants could not see the scale and two pages of notebook paper were placed on top of the scale. The clipboard was placed next to each computer before participants entered the lab. The directions were read aloud in a neutral tone, followed by a period dedicated to answering any questions that the participants had about the experiment. The directions explained that the participants would read scenarios and rate a group of words following each scenario on the computer. After participants read the scenario, the participants proceeded to rate the words. Participants rated on a 5-point scale, 1= indicating totally irrelevant and 5= signifying extremely relevant. The rating responses were displayed below the presented stimulus, and participants responded on the keyboard by pressing only the number keys and the space bar, when directed by the computer program.

After participants read each scenario and rated each group of words, the participants sat in silence until everyone finished. After completion, participants shut off the computer monitor and picked up the clipboard and pen. There was a two-minute distractor task where participants listed as many states in the United States that they could remember.

After two minutes, participants flipped over that piece of paper and moved onto the next sheet of notebook paper. Participants were then given instructions to write down as many words as they could recall from the rating task in five minutes. The participants then flipped over the sheet of notebook paper and completed the Need for Cognition scale. After each participant finished and materials were collected, participants were given a debriefing form and were thanked for participating in the research.

Results

A 2 (Scenario: Survival, Moving) X 2 (NFC: High-NFC, Low-NFC) mixed-subjects design analysis of variance (ANOVA) was conducted to evaluate the effect of the processing task of scenario and NFC on the amount of words recalled. The scenario variable was a within-subjects variable and NFC was a between-subjects variable. The means and standard deviations are in Table 1. A median split on participants' NFC scores was created to divide participants in high-NFC (N= 26) and low-NFC (N= 26) groups, as Graham (2007) performed. The median score was 69 and the NFC scale scoring range is 18 to 90. The data from the three participants whose NFC score fell on the median were not analyzed.

The ANOVA demonstrated that there was a main effect of scenario, $F(1, 50) = 8.48$, $MSE = 4.09$, $p = .005$, $\eta_p^2 = .145$, and as predicted the survival scenario led to greater recall than the moving scenario. There was no main effect of the NFC split. Although there was also no significant interaction, the results demonstrated the differences in the processing task with the adaptive memory effect as predicted.

Experiment 2

Repeated recall tests have been demonstrated to provide an increase in recall. This is known as the hypermnesia effect (Roediger & Thorpe, 1978). The second experiment was focused on exploring the recall of true and false memories by adding additional recall tests due to the fact that multiple recall tests have been shown to have an effect on high-NFC individuals (Leding, 2011).

Method

Participants. Sixty-eight University of North Florida undergraduates participated for extra credit towards their Psychology course or for compensation of five dollars. The

compensation was supplied from the University of North Florida Graduate Research Grant. There were 55 women and 13 men. Out of the sixty-eight participants 97.1% were native English speakers and 2.9% were not. The ages ranged from 18 to 52 (M = 22.12, SD = 6.03). Informed consent was obtained from each participant. Students were tested individually or in a group of up to four individuals. Students were tested in sessions that lasted approximately forty minutes.

Materials. The six DRM lists that elicit the highest levels of false recall were used (Stadler, Roediger, & McDermott, 1999). Sixty words were rated and blocked in trials of ten words in the form SMSMSM or MSMSMS, ensuring that each word was rated under both scenarios by different participants. A Need for Cognition Scale was completed. The Cronbalch's alpha for the NFC scale was .91.

Procedure. For experiment two, after participants read the scenarios, they moved forward to rating words. The materials consisted of four pieces of notebook paper and the NFC scale. The clipboard was organized with the NFC scale placed upside down first, so it was not visible, and the four pieces of notebook paper on top. After completion, participants shut off their computer monitor and picked up the board and pen. Participants had the same two-minute distractor task as experiment one. When two minutes were completed, the participants were instructed to write "T-1" on the top of the next sheet of notebook paper. Participants wrote down as many words as they could recall from the computer program. Participants were allotted five minutes for recall. The participants were given a verbal one minute warning during the final minute. After completion of the first test, participants placed that sheet of notebook paper to the side upside down and labeled the next sheet of notebook paper "T-2." Participants recalled as many words as they could from the computer program again for five minutes. The participants were again given a verbal one minute warning during the final minute. After completion of the

second test, participants placed that sheet of notebook paper to the side upside down and labeled the next sheet of notebook paper "T-3." The final recall task was also five minutes. The participants were given a verbal one minute warning. After completion of the third test, participants placed the sheet of notebook paper to the side upside down and completed the Need for Cognition scale. After participants finished and materials collected, participants were given a debriefing form and were thanked for participating in the research.

Results

Two 3 (Recall Test: Test 1, Test 2, Test 3) X 2 (Scenario: Survival, Moving) X 2 (NFC: High-NFC, Low-NFC) mixed-factors ANOVAs were calculated on true and false recall separately. The recall test and scenario were within-subjects variables, and NFC was a between-subjects variable. The means and standard deviations are located in Table 2. A median split on participants' NFC scores was created to divide participants in high-NFC (N = 31) and low-NFC (N = 33) groups. The median score was 62. The data from the four participants whose NFC score fell on the median were not analyzed.

The first ANOVA conducted was performed on the target words. Results indicated that there was a significant main effect for recall test $F(2, 124) = 6.71$, $MSE = 3.72$, $p = .002$, $\eta_p^2 = .10$. Post hoc analyses using the Least Significant Difference correction concluded that test three was significantly higher than test one and test two, but test one and test two were not significantly different from each other. There was also a main effect for scenario $F(1, 62) = 4.47$, $MSE = 37.09$, $p = .039$, $\eta_p^2 = .07$, indicating that the survival scenario led to greater recall than the moving scenario. The main effect of NFC and the interactions were not significant.

The results for false memories indicated that there was a significant main effect for test $F(2, 124) = 10.22$, $MSE = .26$, $p < .001$, $\eta_p^2 = .14$. Post hoc analyses using the Least Significant

Difference correction were conducted. Test one was significantly lower than recall test two and test three. Recall test two and test three were not significantly different from each other. Similar to the results for target words, participants recalled more words in the subsequent tests. There was a significant interaction between recall test and NFC split $F(2, 124) = 3.25$, $MSE = .26$, $p = .042$, $\eta_p^2 = .05$. The interaction indicated that high-NFC individuals gradually increased recall from test one to test three, but low-NFC individuals did not have a steady increase in recall through the recall tests. The other main effects and interactions were not significant.

The third ANOVA was a 3 (Recall Test: Test 1, Test 2, Test 3) X 2 (NFC: High-NFC, Low-NFC) mixed factors ANOVA conducted on the foil words which are words that were not on the word list or critical lures, from the participants. Recall test was a within-subjects variable and NFC was a between-subjects variable. The ANOVA resulted in a significant main effect of test $F(2, 124) = 7.10$, $MSE = 2.65$, $p = .001$, $\eta_p^2 = .10$. Post hoc analyses using the Least Significant Difference correction were conducted. The post hoc test revealed that all of the tests were significantly different from each other, with recall increasing across subsequent tests. The results suggest that as the participants continued to recall words, the participants increased in recalling words that were not presented and also not considered critical lures. There was not a significant difference for NFC split nor an interaction between NFC split and test.

Discussion

The current study aimed to examine the adaptive memory effect for high and low-NFC individuals. In study one it was hypothesized that individuals with high-NFC would recall more words than low-NFC individuals and the survival scenario would lead to greater recall than the moving scenario. It was also predicted that individuals with high-NFC would demonstrate a stronger overall adaptive memory effect than low-NFC individuals. As predicted, in experiment

one there was a main effect of scenario indicating that the survival scenario led to greater recall than the moving scenario, which has been found in past research regarding the adaptive memory effect. There were no differences between high- and low-NFC individuals. Payne and Roediger (1987) indicate that memory performance increases with repeated testing. For there to be an effect of adaptive memory, high-NFC individuals may need repeated testing to increase their chances at recall. Repeated recall tests have been demonstrated to provide an increase in recall, also known as the hypermnesia effect (Roediger & Thorpe, 1978). The second experiment explored this idea that the recall of true and false memories would increase by adding additional recall tests, because it has been shown to have an effect on high-NFC individuals (Leding, 2011).

Experiment two explored true and false memories in the adaptive memory effect for high-NFC and low-NFC individuals. For study two it was hypothesized that high-NFC individuals would recall more true and false words than low-NFC people and the survival scenario would lead to greater true and false recall than the moving scenario in three separate recall tests. It was also predicted that individuals with a high-NFC would recall more true and false words from the overall DRM lists than individuals with low-NFC. The target words had a significant effect for recall test as well as for scenario. These results indicate that there were more true words recalled as the participants took multiple recall tests. The participants also remembered more words in the survival scenario condition than in the moving scenario condition.

To explore the participants' false memories, the critical lures were examined. There was a significant effect for recall test, but not for scenario nor NFC split. Similarly to the target words, the results indicate that as the participants participated in multiple tests, the participants recalled more false words. There was a significant interaction between recall test and NFC split,

which indicates that high-NFC individuals, unlike low-NFC individuals, gradually increased in recall from test one to test three. The current study did not find a significant effect of scenario for false memories. The non-significant results for scenario are different from what Otgaar and Smeets (2010) found. They found that both true and false recall is amplified by survival processing, compared to alternative scenarios. An explanation for the different results is that Otgaar and Smeets used a different set of lists when studying the adaptive memory effect. Otgaar and Smeets used words that were semantically related and included critical lures in the Dutch language, which were specifically related to survival. That is, the words were considered to be words that would specifically elicit the idea of surviving for the participants. The Dutch DRM lists that were more related to survival might have encouraged a different effect for the participants than the lists used in the current study, because the participants who read the survival materials were given an advantage.

Foil words were also examined. There was a significant effect of recall test but no significant interaction between NFC split and recall test. Just as in the first two analyses, the participants increased in foil recall when the participants completed multiple recall tests. Once again, there was no difference of whether the participant had a high or low-NFC, implying that the participants' NFC does not affect their recall in the adaptive memory effect.

Cacioppo et al. (1996) discussed that if individuals are thinking about and elaborating on information, then they should remember this information better than if they are not putting much effort into the information. The more an individual engages in thought, the better memory they will experience later. Kroneisen and Erdfelder (2011) suggested that relevance ratings in a complex survival scenario such as the one used in the present studies provide richer encoding compared to control scenarios. The richness-encoding hypothesis suggests that the standard

survival scenario gives the participants a rich, and more distinctive encoding, ultimately increasing the survival processing advantage. The deeper type of encoding may be activated because the individuals are thinking about items that help them survive. Therefore, participants may be more motivated to generate many different survival ideas that are then used as retrieval cues during recall (Röer et al., 2012). Participants who are more motivated to generate different ideas, or increase their thinking, are considered high-NFC individuals. High-NFC individuals have been shown to engage and participate in effortful thinking. It was hypothesized that if high-NFC individuals are more likely to elaborate on the words rated in the survival scenario, then they should have a stronger adaptive memory effect than low-NFC individuals. This hypothesis was supported by the work of Kroneisen and Erdfelder, as they discussed that relevance ratings in a complex survival scenario provide a predominantly inspiring and rich encoding context, which enables elaborate and distinctive encoding when compared to a simple survival scenario.

Research has also shown that individuals with a high NFC are more likely to experience false memories (Graham, 2007; Leding, 2011). This is due to their greater elaboration of learned items in memory, because individuals think of semantically related items. Although the results of Graham's and Leding's studies are different from the results of the current study, it is possible that both the survival and moving scenarios elicited deep, relational processing.

For example, past research has demonstrated that high-NFC individuals engage and participate in effortful thinking. In the current study there was not a significant difference in NFC individuals and their adaptive memory effect. High- and low-NFC individuals process information differently, unless they are prompted to process in a specific way. That is, high-NFC individuals are typically more likely to engage in deeper processing of the study items, which in

turn provides them with the ability to produce higher rates of target and false memories within the DRM paradigm (Graham, 2007; Leding, 2011). Wootan and Leding (in press) found that when individuals are prompted to process the items in a certain way, there was not a great difference in high- and low-NFC individual recall. Their experiment tested the idea that high-NFC individuals tend to process information more elaborately, while low-NFC individuals put in little cognitive effort into processing information (Cacioppo & Petty, 1982). Wootan and Leding manipulated participants' levels of processing by either encouraging the participants to have a deep processing or shallow processing for the words given. For deep processing, the participants were instructed to think about the meaning of the words and then give a pleasantness rating for each word. For shallow processing, the participants were instructed to look at the word and indicate whether that word contained the letter "e" and writing yes or no on their sheets of paper. The goal of the experiment was to test whether instructing participants to process items in specific ways, could influence the participants' true and false memories regardless of their level of NFC.

Wootan and Leding found that high-NFC individuals produced higher rates of true memories, compared to low-NFC individuals, in the deep processing condition. In regards to false recall, there was a lack of difference between NFC groups in the deep processing condition. This indicated that the low-NFC group processing level was successfully increased to a level similar to that of high-NFC individuals. This resulted in similar rates of false memories for both high- and low-NFC individuals. Wootan and Leding did however show that the high-NFC group still produced higher rates of false recall in the shallow processing condition when compared to the low-NFC group. Their results demonstrated that even though the researchers were able to change the low-NFC participants' processing style to a deeper processing, it may not be possible

to manipulate the high-NFC individuals' processing style to a shallower processing. External manipulations to the levels of processing may in fact enhance the encoding style of low-NFC participants, giving them a better chance at recall. Both survival and moving scenarios are considered deep types of processing and have been shown to increase participants' memory. Perhaps, because in the present study the individuals were prompted to use deeper processing in both the survival and moving scenarios, the difference for high- and low-NFC individuals was reduced or eliminated.

A limitation of the present experiments could be the within-subjects scenario variable. Participants read both survival and moving scenarios, and then rated the words according to the provided directions. Therefore, participants had the opportunity to encode both scenarios. There may have been a carryover effect while the participants read each of the scenarios. The question at hand may be whether the performance in the first condition affects the performance in the second condition. In order to better observe the distinct differences between survival and moving processing for high- and low-NFC individuals the scenarios may need to be a between-subjects variable.

Conclusion

The present experiments replicate the adaptive memory effect, which is the concept that survival processing produces high levels of recall. The current and past research demonstrates that memory is enhanced when information is processed because of its relevance of helping an individual survive (Nairne et al., 2007). The hypermnesia effect also influenced participants' recall, similar to past research. Unfortunately, there was no demonstration of a difference between high- and low-NFC individuals with the adaptive memory effect. Though there may be limitations in the present study, this research provides insight for future studies in adaptive

memory and individual differences. Wootan and Leding discovered that prompting deep processing succeeded in increasing true and false memories for the low-NFC group to a level similar to that of their high-NFC individual counterparts. Future studies can explore the distinctive differences in high- and low-NFC individuals and study the scenario variable as a between-subjects variable while paying more attention to the manipulation of levels of processing. Studies could also examine whether high-NFC individuals do think of more uses of items in the survival scenario when compared to low-NFC individuals. This may help reveal the distinct differences between survival and moving processing for high- and low-NFC individuals.

Table 1

Mean Recall Performance for Experiment One.

	High-NFC	Low-NFC
Moving	6.46 (2.47)	6.23 (1.77)
Survival	7.69 (2.54)	7.32 (2.51)

Note. Standard deviations are in parentheses.

Table 2

Mean Recall Performance for Experiment Two.

	Test 1	Test 2	Test 3
Target Words			
High-NFC			
Survival	12.68 (4.08)	13.00 (4.20)	13.61 (4.15)
Moving	12.10 (4.45)	10.84 (4.81)	12.26 (4.61)
Low-NFC			
Survival	11.70 (4.51)	11.58 (4.29)	12.48 (4.52)
Moving	10.21 (3.60)	10.70 (4.19)	11.06 (3.96)
Critical Lures			
High-NFC			
Survival	.90 (.94)	1.26 (1.15)	1.32 (1.17)
Moving	.97 (.91)	1.16 (.97)	1.39 (1.02)
Low-NFC			
Survival	.91 (.77)	1.18 (.88)	1.15 (.94)
Moving	1.03 (.95)	1.12 (.93)	1.00 (.90)
Foil Recall			
High-NFC	.90 (1.74)	1.42 (2.58)	2.03 (3.98)
Low-NFC	.82 (.92)	1.58 (2.09)	1.85 (2.22)

Note. Standard deviations are in parentheses.

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Education

Spring 2016	Master of Science, General Psychology	University of North Florida, Jacksonville, FL
Spring 2014	Bachelors in Science, Major in Psychology, Minor in Ethics	University of North Florida, Jacksonville, FL

Research Experience

Foster Care Teenage Reproductive Health with Stephanie Toelle, MS, CFLE 2015 – Present

- **Caregivers, Caseworkers and Biological Parents: Risk Factors for Foster Teen Pregnancy & Understanding What You Can Do:** Provide information about the physical, emotional and psychological health concerns related to teen reproductive health in the foster care system.
    - **Publication:** *(In review)*

Adaptive Memory Research Lab with Dr. Leding 2013 - Present

- **The Need For Cognition and False Memories:** Examine if an individuals Need for Cognition is related to the amount of recall of true and false words
- **Adaptive Memory and The Need For Cognition (Thesis):** Study the Adaptive Memory effect in regards to an individuals Need for Cognition

Bonner Foundation Research Lab with Dr. Richard 2015-Present

- **Civic Minded Professional in College Business Programs:** Examines the relationship of civic minded professionals and their service-learning courses within college

Work Experience

Research Assistant, UF/IFAS Extension Office Duval County 2015 - 2016

- Assist task force with data collection, training and qualitative analysis for focus groups
- Research roles, legal consent, and risk factors of foster youth regarding reproductive health
- Write curricula, policy briefs and fact sheets regarding research and literature reviews

Teachers Assistant-Applied Developmental, University of North Florida 2014 – 2016

- Facilitate and demonstrate student presentations
- Engage in class and individual discussions
- Evaluate student essays and presentations and gave constructive revisions

Head Start Internship, Callahan FL Head Start **2013 - 2014**

- Design learning strategy plans for children with difficulties and gain optimal results
- Monitor children's everyday behaviors for change and/or development
- Calibrate with families to develop home efficiency plans

Counseling Intern, JMJ Life Center; St. Cloud **2013 - 2014**

- Observe and collaborate in counseling sessions
- Communicated guidance and support to the individuals in need
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Associations

- American Psychological Association, Student Affiliate, 2014 – present
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Conferences

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